Induction Equation with Bounded Driven Current (Archive Grade)

Governing Equation (ASCII-safe)

dB/dt = curl(v x B) + eta * Laplacian(B) - mu0 * eta * curl(J_drv)

Driven Current Definition

J_drv = C(x,t) * J_ionic, where 0 <= C <= 1

Definitions

B : magnetic flux density (Tesla)
v : bulk velocity field (m/s)
eta : magnetic diffusivity = 1/(mu0*sigma) = eta_res/mu0 (m^2/s)
J_ionic : baseline ionic current density (A/m^2)
J_drv : bounded driven current density (A/m^2)
C(x,t) : dimensionless gating factor (0 <= C <= 1)

Assumptions

1. div(B) = 0
2. Displacement current neglected (quasi-static MHD regime)
3. eta is uniform or piecewise-constant over the domain
4. Driven current enters through the resistive closure only
5. Energetic contribution from the driver is bounded by available physical power sources

*Note: If eta varies spatially, replace eta*Laplacian(B) with curl(eta * curl(B)).*